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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/457,929	12/08/1999	JACK CHIHCHIEH YAO	A-64873-1/AJ	8226

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EXAMINER	
LUND, JEFFRIE ROBERT	
ART UNIT	**PAPER NUMBER**
1763	16

DATE MAILED: 06/04/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

MF-16

Office Action Summary	Application No.	Applicant(s)	
	09/457,929	YAO ET AL.	
	Examiner	Art Unit	
	Jeffrie R. Lund	1763	

-- The MAILING DATE of this communication app ars on th cover she t with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 April 2002* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4,6 and 8-11* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,6 and 8-11* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *08 December 1999* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. Claims 1, 3, 4, 6, 8, 10, and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over McDiarmid US patent 5,242,501.

McDiarmid teaches a circular plate susceptor (wafer carrier) 216, 316 that has a flat edge extending around the circumference of the plate, and a circular recess center region 220, 320 having a recessed bottom surface 222, 322 and including an upwardly inclined surface 221, 321 around the periphery of the recess bottom. The substrate is supported by a portion of the upwardly inclined surface and is spaced apart from the recessed bottom surface such that the substrate is supported by the wafer carrier only around the periphery edge of the substrate (see column 4 lines 65-67). The susceptor is made out of graphite, which has a coefficient of thermal expansion in the range of 2.6 x 10^{-6} to 5 x 10^{-6} /°C that enables the upwardly inclined surface to maintain contact substantially entirely around the peripheral edge of the substrate during processing at elevated temperatures, and a thermal conductivity of 40 to 70W/m/K. McDiarmid also teaches that the dimensions of the susceptor can be optimized to fit a variety of size substrates, and the space between the substrate and susceptor can be optimized to control the heat flow from the susceptor to the substrate. (Entire document)

McDiarmid does not teach that the edge region has a width of 5 to 25 mm, the upwardly inclined surface is inclined at an angle of 5° to 45°, specifically, 10°, the recess is 200 mm or 300 mm (to fit a 200 or 300 mm substrate), or that the space between the back of the substrate is between 0.15 mm to 0.5 mm, specifically, 0.25 mm.

The motivation for sizing the recess to a specific size is to hold a specific size substrate, the motivation for optimizing slope of the incline and therefore the size of the space between the substrate and the susceptor is to optimize the heat flow between the susceptor and the substrate, both of which are taught by McDiarmid. The motivation for optimizing the size of the flat region is to optimize the heating of the outer edge of the wafer and optimizing the gas flow across the wafer. Furthermore, it was held in *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984), by the Federal Circuit that, where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device. (Also see MPEP 2144.04 (d))

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention was made to: size the recess to 200 or 300 mm; make the upwardly inclined surface an angle of 5° to 45°, specifically, 10°, to size the space between the susceptor to 0.15 to 0.5 mm, specifically, 0.25 mm; and to size width of the flat area of the susceptor to 5 to 25 mm.

2. Claims 1-4, 6, 8, 10, and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over MacLeish et al, US Patent 5,891,251.

MacLeish et al teaches a circular plate susceptor (wafer carrier) 50 that has a flat edge extending around the circumference of the plate; a circular recess center region having a recessed bottom surface 51c and including an upwardly inclined

surface 51b around the periphery of the recess bottom; and a support member 54 to engage the substrate. The substrate is supported by a portion of the upwardly inclined surface and is spaced apart from the recessed bottom surface such that the substrate is supported by the wafer carrier only around the periphery edge of the substrate. The susceptor is made out of graphite, which has a coefficient of thermal expansion in the range of 2.6×10^{-6} to 5×10^{-6} /°C that enables the upwardly inclined surface to maintain contact substantially entirely around the peripheral edge of the substrate during processing at elevated temperatures, and a thermal conductivity of 40 to 70W/m/K. (Entire document) MacLeish et al does not disclose any dimensions in the drawings, specification, or claims.

MacLeish et al does not teach that the recess is 200 mm or 300 mm (to fit a 200 or 300 mm substrate), the space between the back of the substrate is between 0.15 mm to 0.5 mm, specifically, 0.25 mm, the upwardly inclined surface is inclined at an angle of 5° to 45°, specifically, 10°, or that the flat edge region of the susceptor is 5 to 25 mm wide.

One of ordinary skill in the art at the time the invention was made after reading the specification of MacLeish et al would be motivated to build the apparatus of MacLeish et al and find the optimum dimensions for each of the parts of the apparatus to ensure that the apparatus would function as taught by MacLeish et al. Furthermore, it was held in *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984), by the Federal Circuit that, where the only difference between the prior art and the claims was a recitation of

relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device. (Also see MPEP 2144.04 (d))

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention was made to: size the recess to 200 or 300 mm; size the space between the susceptor to 0.15 to 0.5 mm, specifically, 0.25 mm; and to size the flat edge region of the susceptor to 5 to 25 mm.

3. Claims 1, 8, and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Grabmaier et al, US Patent 3,151,006 in view of McDiarmid.

Grabmaier et al teaches a flat polycrystalline silicon susceptor 1 for holding single crystal silicon substrates. (Figure 1)

Grabmaier et al differs from the present invention in that Grabmaier et al does not teach a circular plate susceptor (wafer carrier) that has a flat edge extending around the circumference of the plate; a circular recess center region having a recessed bottom surface and including an upwardly inclined surface around the periphery of the recess bottom, or that the substrate is supported by a portion of the upwardly inclined surface and is spaced apart from the recessed bottom surface such that the substrate is supported by the wafer carrier only around the periphery edge of the substrate.

McDiarmid was discussed above and further teaches that supporting a wafer on a flat surface causes the wafer to warp and introduces defects in to the layer. (Fig 3, col. 2 line 60 through col. 4 line 3)

The motivation for changing the shape of the susceptor of Grabmaier et al from a rod to a circle is to provide an alternate and equivalent shape of the susceptor. It has been held that a change in shape is a matter of choice, which a person of ordinary skill in the art would have found obvious. (See *In re Dailey*, 357 F.2d 669,149 USPQ 47 (CCPA 1966) MPEP 2144.04 (d)) The motivation for adding the recess and supporting the substrate by its peripheral edge is to prevent the wafer from warping as taught by McDiarmid.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention was made to make the susceptor of Grabmaier et al round and to support the substrate in a recess by its peripheral edge to prevent the substrate from warping as taught by McDiarmid.

4. Claims 1, and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Inoue et al, US Patent 5,677,253 in view of McDiarmid.

Inoue et al teaches a round flat aluminum nitride susceptor 1 for holding a substrate (Entire document)

Inoue et al differs from the present invention in that Inoue et al does not teach a susceptor; a circular recess center region having a recessed bottom surface and including an upwardly inclined surface around the periphery of the recess bottom, or that the substrate is supported by a portion of an upwardly inclined surface and is spaced apart from the recessed bottom surface such that the substrate is supported by the wafer carrier only around the periphery edge of the substrate.

McDiarmid was discussed above and further teaches that supporting a wafer on a flat surface causes the wafer to warp and introduces defects in to the layer. (Fig 3, col. 2 line 60 through col. 4 line 3)

The motivation for adding the recess and supporting the substrate by its peripheral edge is to prevent the wafer from warping as taught by McDiarmid.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention was made to add the recess, and support the substrate by its peripheral edge to prevent warping as taught by McDiarmid.

5. Claims 3, and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over MacLeish et al in view of Haafkens et al, US Patent 4,403,401.

MacLeish et al was discussed above.

MacLeish et al differs from the present invention in that MacLeish et al does not teach a susceptor made of silicon carbide, aluminum nitride, silicon or silicon/silicon carbide alloy that holds a 200 mm wafer.

Haafkens et al teaches a susceptor made of graphite with an aluminum nitride or silicon carbide layer for holding a 200 mm wafer. (Abstract, col. 3 lines 27-30, claim 6)

The motivation for coating the susceptor of MacLeish et al with a layer of aluminum nitride or silicon carbide is to prevent the graphite susceptor from warping as taught by Haafkens et al. The motivation for making the recessed region about 200 mm is to hold a 200 mm wafer as taught by Haafkens et al.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to coat the susceptor of MacLeish et al with an aluminum

nitride or silicon carbide layer, and make the recess 200 mm in diameter to hold a 200 mm substrate as taught by Haafkens et al.

6. Claims 3, and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over MacLeish et al in view of Chen et al, US Patent 5,837,058

MacLeish et al was discussed above.

MacLeish et al differs from the present invention in that MacLeish et al does not teach a susceptor made of silicon carbide, aluminum nitride, silicon or silicon/silicon carbide alloy that holds a 200 mm wafer.

Chen et al teaches a susceptor made of graphite with an aluminum nitride layer for holding a 200 mm wafer.

The motivation for coating the susceptor of MacLeish et al with a layer of aluminum nitride is to protect the graphite from damage caused by chemical attack as taught by Chen et al. The motivation for making the recessed region about 200 mm is to hold a 200 mm wafer as taught by Chen et al.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to coat the susceptor of MacLeish et al with an aluminum nitride layer, and make the recess 200 mm in diameter to hold a 200 mm substrate as taught by Chen et al.

Response to Arguments

7. Applicant's arguments filed March 3, 2002 have been fully considered but they are not persuasive.

In regard to the arguments directed to McDiarmid, specifically, that the susceptor of McDiarmid causes the wafer to bow that causes the peripheral edge of the wafer to come off the susceptor, and that McDiarmid is concerned about the size of the side walls to accommodate the bowing of the wafer, the examiner disagrees. The applicant has applied the specification of McDiarmid in a piecemeal manner and has made the argument based on parts of the specification taken out of context. In col. 3 lines 35-43 McDiarmid discusses problems resulting from heating a wafer on a flat susceptor of the prior art. McDiarmid teaches that the bottom surface of the wafer is heated by conduction and is hotter than the top surface of the wafer. This results in the bottom surface of the wafer expanding more than the top surface, which results in the wafer bowing. As the wafer bows the outer edge separates from the susceptor and further increases the thermal gradient, which results in even greater bowing (col. 3 lines 30-54). In contrast, in col. 5 lines 12-24 McDiarmid discloses how an improved susceptor discussed in col. 4 line 65 through col. 5 line 11 works and over comes the problems found in the prior art. In col. 5 lines 1-4 McDiarmid clearly teaches that the wafer is heated by conduction from the edge of the wafer in contact with the susceptor. Clearly, McDiarmid must keep the edge of the substrate in contact with the sloped part of the susceptor 221, 321 in order to support the substrate and to continue to heat the substrate. If the edge of the wafer does not remain in contact with the susceptor a larger temperature gradient and bowing will result causing greater slip, thus, McDiarmid's concern for the sidewall and accommodating the bowing of the wafer.

In regard to the arguments directed to graphite, specifically, graphite cannot provide the dimensional stability needed to meet the recited limitations, that graphite is less predictable during heating, or the ease of working and the cost of construction, the examiner disagrees. Claim 1 only requires "a material having a coefficient of thermal expansion in the range of 2.6×10^{-6} to 5×10^{-6} /°C". A material that has this coefficient of thermal expansion will "enable the upwardly inclined surface to maintain contact substantially entirely around the peripheral edge of the substrate during processing at elevated temperatures such that deposition on the backside of the substrate is substantially prevented." Therefore, the only material property required is the proper coefficient of thermal expansion. Graphite meets this limitation. Any other considerations are mute because they are not claimed.

In regard to the argument s directed to MacLeish et al, specifically, that the susceptor of MacLeish et al is not thermally matched to the wafer, and that MacLeish et al suggests that a minimum number of points of contact along the outer edge means less than the entire periphery, the examiner disagrees. Thermal matching of the susceptor and wafer is not claimed. As to whether MacLeish teaches that the minimum contact is along the entire periphery as asserted by the examiner or only part of the periphery as asserted by the applicant, the examiner refers the applicant to column 5 lines 5-20 and figures 3A, 3B and 5. Clearly MacLeish et al teaches that the susceptor 50 supports the wafer 52 on a minimum number of points along a slope 51a (figure 3B). Looking at figure 5 shows a top view of the susceptor 50, supporting the wafer 52. Note that the only support shown is the inclined slope, and that no other supports are shown

for supporting the wafer 52 in any other way, except, for along the entire periphery of the wafer 52. Therefore, it is clear that when MacLeish et al taught minimizing the number of contact points MacLeish et al meant engaging the wafer at a single contact point (i.e. the point the edge of the wafer meets the sloped portion of the susceptor) along the entire periphery of the wafer as shown in figure 5.

In regard to the arguments directed to Grabmaier et al, Chen et al, Inoue et al, and Haafkens et al, specifically, that there is no motivation to make the combination, or that the combination does not teach the claimed invention, the examiner disagrees. Applicant's arguments are directed to individual references not the combination of the references. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). The motivation to combine is clearly taught in the secondary references, and is specifically spelled out in the rejections above.

In regard to the argument that the combination of Inoue et al and McDiarmid would destroy the intended purpose of Inoue et al, the examiner disagrees. The purpose of Inoue et al is to "improve the heat absorbing characteristic of a wafer holding member made of aluminum nitride" (abstract). This purpose is achieved by changing the composition of the holder, i.e. adding impurities to the aluminum nitride. Changing the shape of the holder will not affect the heat absorbing characteristics of the material from which the holder is made. Changing the shape will affect the heat transfer from

the holder to the substrate, which is the motivation to combine Inoue et al and McDiarmid as taught by McDiarmid.

In regard to the argument that the dimension of the flat edge region, specifically, that the specific dimension of this flat edge region are dependent on many factors and are not a matter of simple design, the examiner disagrees. It is true that the optimal size of the flat region varies, and is dependent on a number of variables, such as pressure, temperature, flow rate, reactor geometry, and process being performed. This is well known in the art and applies to every apparatus. After any change in the apparatus or method a simple and routine series of tests must be performed to test the effects of the changes on the output of the reactor. This process can optimize every factor, including the size of the flat edge region. Furthermore, it was held in *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984), by the Federal Circuit that, where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device. (Also see MPEP 2144.04 (d)) Both McDiarmid and MacLeish teach a flat edge region, neither teaches a specific size, so one of ordinary skill in the art must find the optimal size of the flat edge region in order to make the holder of McDiarmid or MacLeish.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Jeffrie R. Lund
Primary Examiner
Art Unit 1763

JRL
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